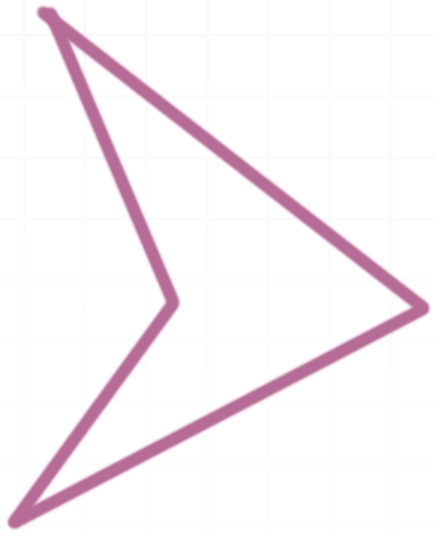
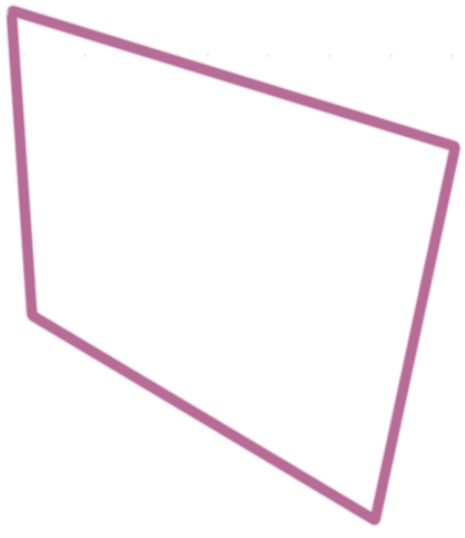
Measures of quadrilaterals

A quadrilateral is any closed four-sided figure. There are two types of quadrilaterals: concave and convex.

A concave quadrilateral has a part that goes into the shape:



A convex quadrilateral has angles all on the outside corners of the shape:



All convex quadrilaterals have four sides (edges), four corners (vertices) and four interior angles that sum to $360°$.

Here are some special types of convex quadrilaterals and their properties:

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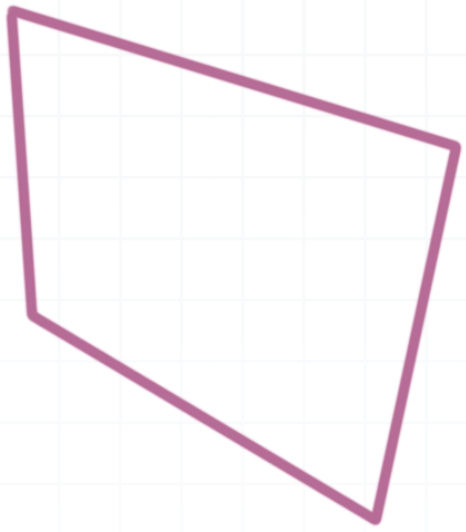
Trapezium

No pairs of parallel sides and no congruent sides

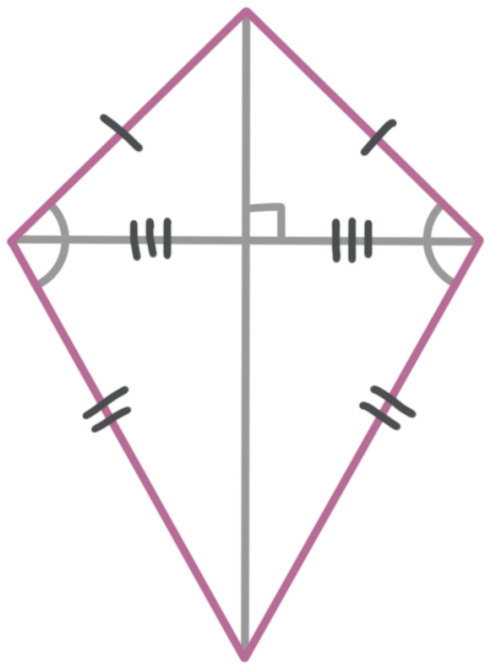


Kite

Has two pairs of adjacent congruent sides

Has a pair of opposite congruent angles

Diagonals cross to form right angles and one of the diagonals bisects the other (cuts it in half)



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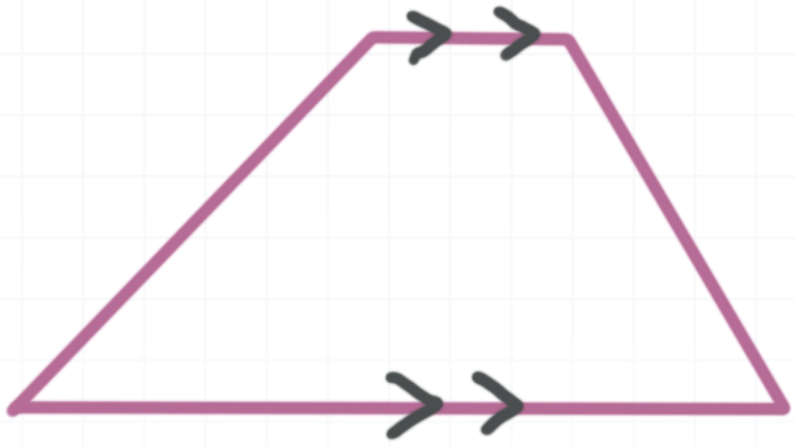
Trapezoid

Has exactly one pair of opposite parallel sides



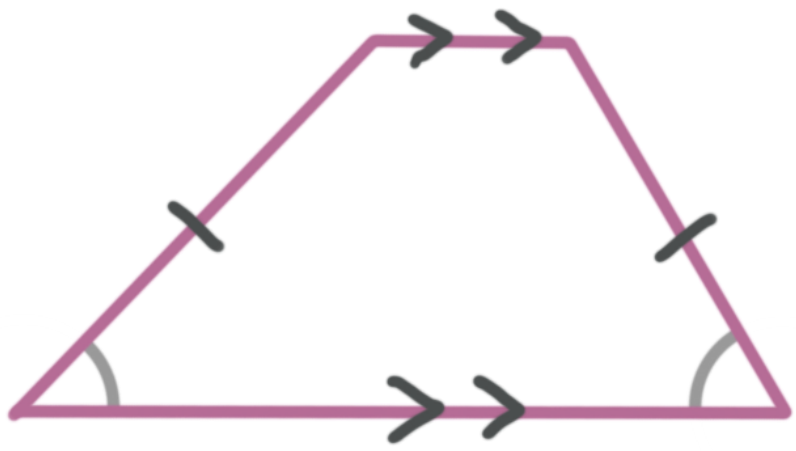
Isosceles trapezoid

Has exactly one pair of opposite parallel sides

Non-parallel sides have equal lengths

Base angles are congruent

Diagonals are congruent



Parallelogram

Two pairs of opposite parallel sides

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Opposite sides are equal lengths

Opposite angles are congruent

$$m\angle 1 = m\angle 3$$

$$m\angle 2 = m\angle 4$$

Consecutive angles are supplementary

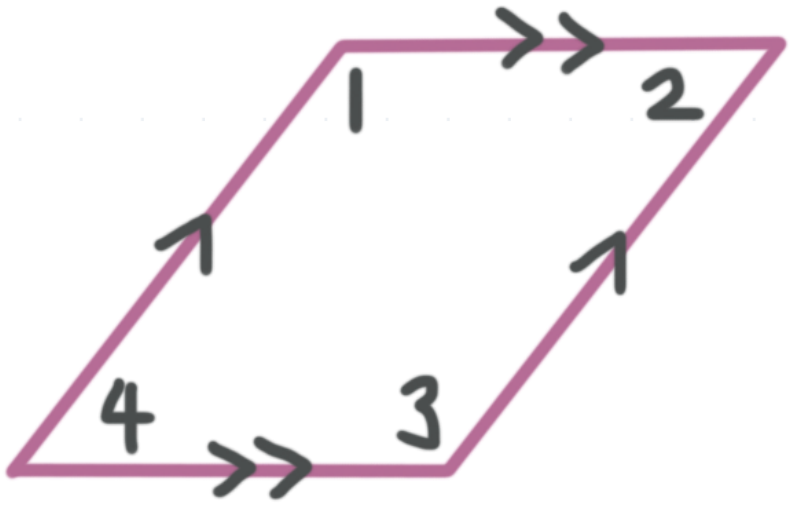
$$m\angle 1 + m\angle 2 = 180^\circ$$

$$m\angle 2 + m\angle 3 = 180^\circ$$

$$m\angle 3 + m\angle 4 = 180^\circ$$

$$m\angle 4 + m\angle 1 = 180^\circ$$

Diagonals bisect each other (cut each other in half)



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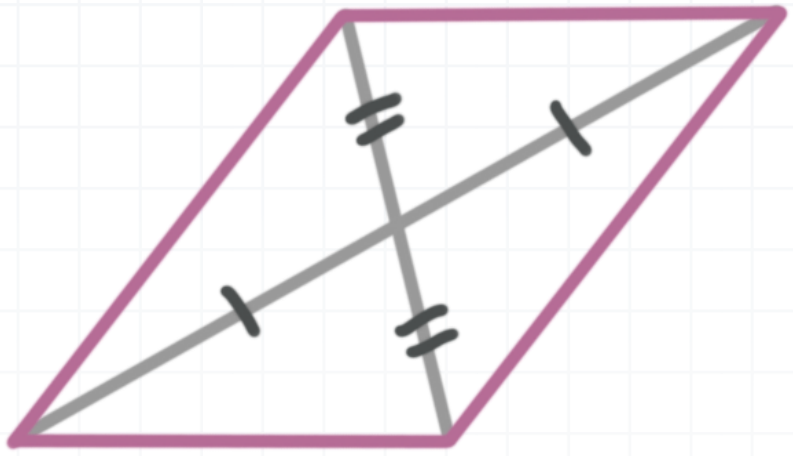


Rectangle

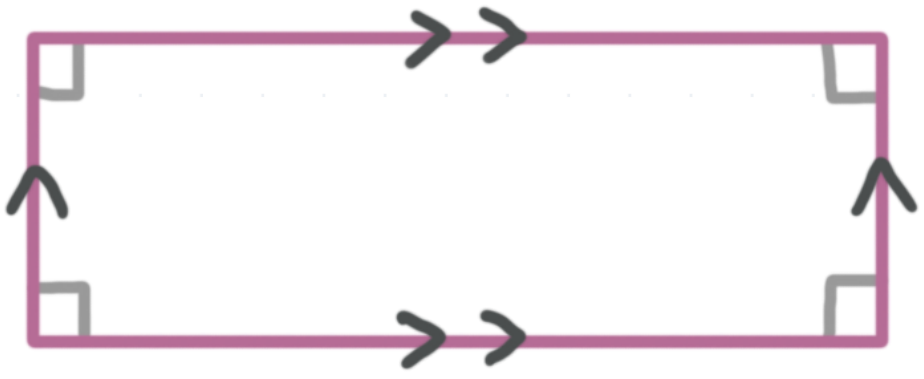
Two pairs of opposite parallel sides

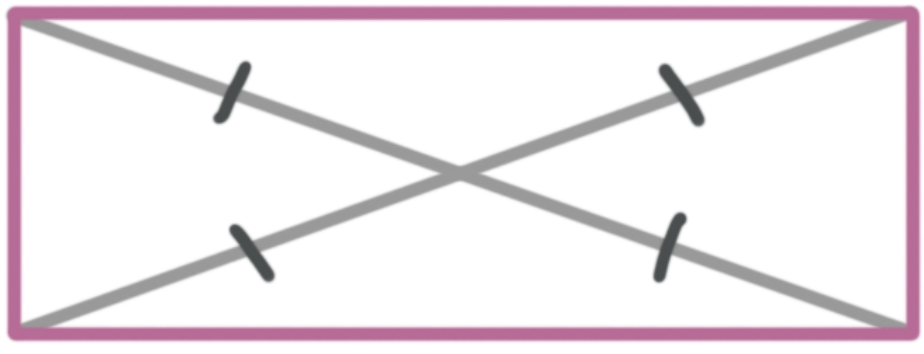
Opposite sides are equal

All angles are right angles ($90°$)

Diagonals bisect each other (cut each other in half)

Diagonals are congruent





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Rhombus/Diamond

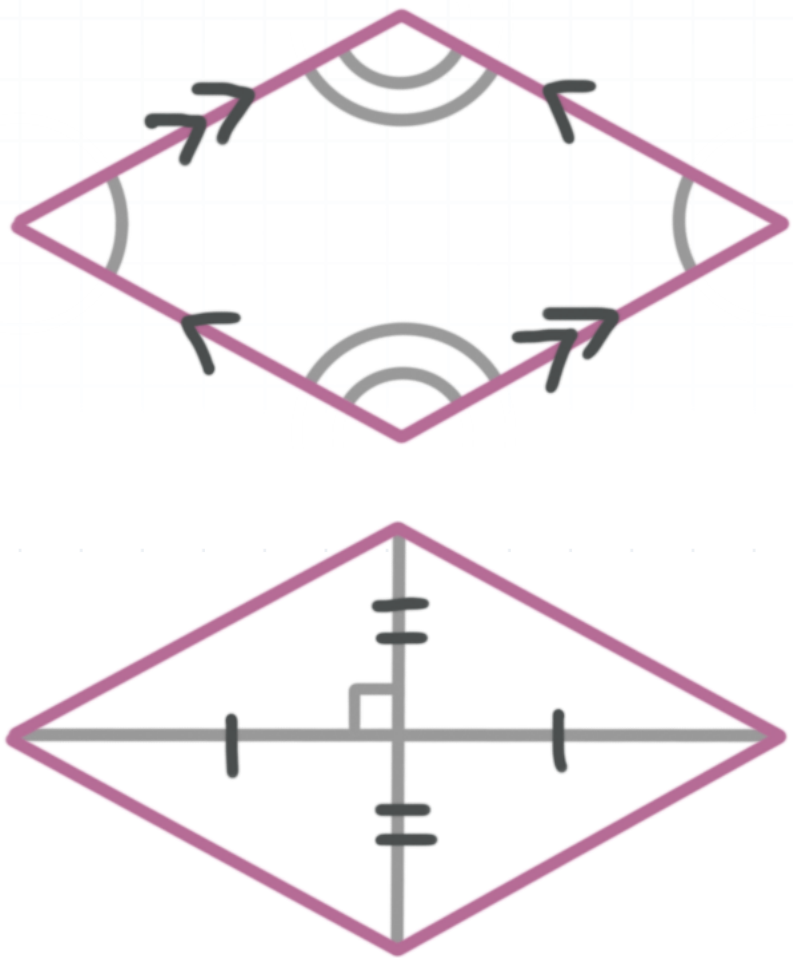
Two pairs of opposite parallel sides

All sides are equal lengths

Opposite angles are congruent

Consecutive angles are supplementary

Diagonals are perpendicular bisectors each other (cut each other in half and form right angles)



Square

Two pairs of opposite parallel sides

All angles are right angles

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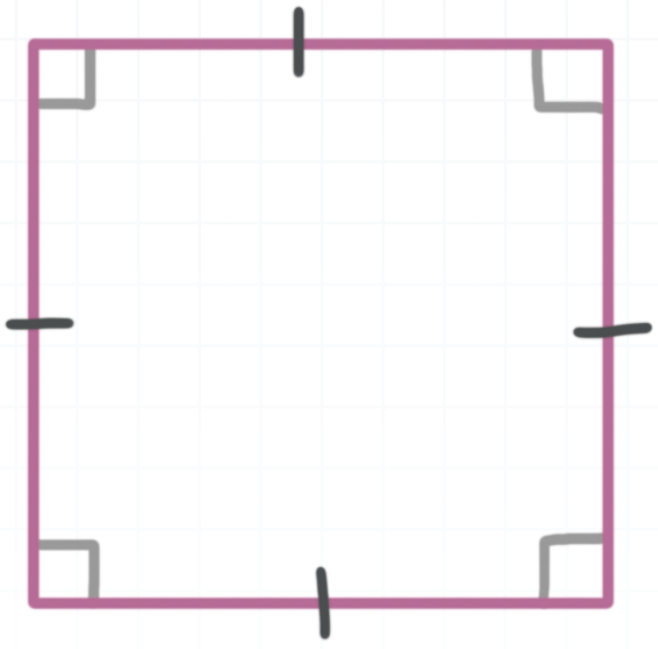
All sides are equal length

Diagonals bisect each other (cut each other in half and form right angles)



Let's start by working through an example.

Example

What is the value of x in the parallelogram?

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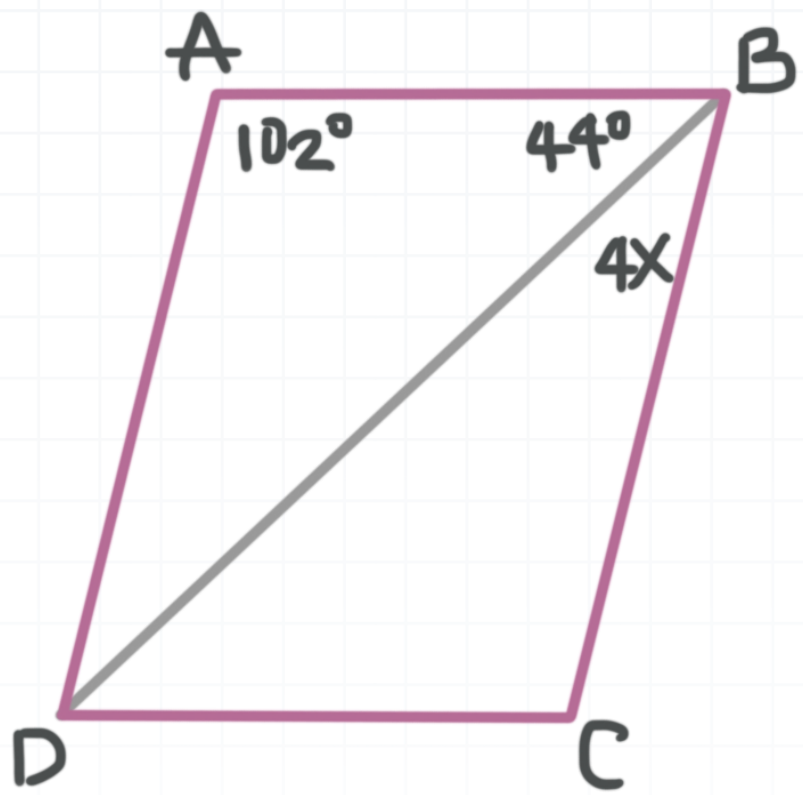

Angles A and B are consecutive angles in a parallelogram (they're next to each other, not across the figure from one another), so they're supplementary. Because $m\angle A = 102^\circ$ and $m\angle B = 44^\circ + 4x$, we can say

$$m\angle A + m\angle B = 180^\circ$$

$$102^\circ + 44^\circ + 4x = 180^\circ$$

$$146^\circ + 4x = 180^\circ$$

$$4x = 34^\circ$$

$$x = 8.5^\circ$$

Let's look at one more example.

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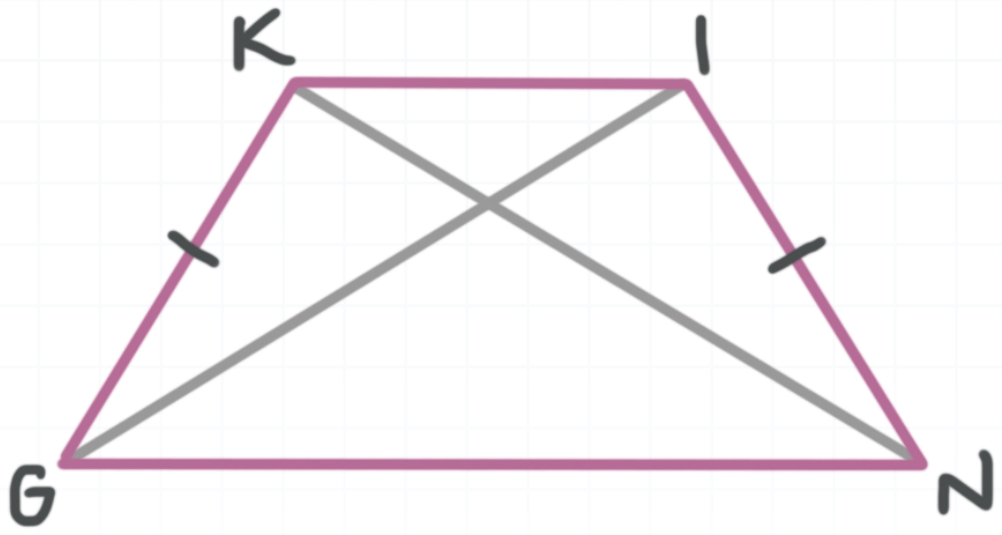
Example

The figure below is a trapezoid. What is the measure of KN if $KN = 5x + 2$ and $IG = 4x + 20$?



The side lengths of KG and IN are marked as being the same length, which means this is an isosceles trapezoid. The diagonals of an isosceles trapezoid are congruent, which means that $KN = IG$. Therefore,

$$KN = IG$$

$$5x + 2 = 4x + 20$$

$$5x = 4x + 18$$

$$x = 18$$

Then the measure of KN must be

$$KN = 5x + 2$$

$$KN = 5(18) + 2$$

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$KN = 92$

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